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Urban Biodiversity: Successes and Challenges: Epigeal invertebrate abundance and diversity on Yorkshire allotments

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ALLOTMENTS: FASCINATING HABITATS

After more than half a century of neglect and decline, allotments are on the brink of a great revival (Foley, 2004). Recent decades in particular have witnessed a growing demand for allotments, partly linked to the demand for healthy, pesticide-free food and an escape from the pressures of modern, busy urban lives. The image of traditional plot-holders e.g. retired men may be slowly changing. Allotment plots are increasingly managed by young women and professional couples keen to grow organic crops or seek an escape from the daily grind (Buckingham, 2005; pers obs). In parallel to the increased interest in the socio-economic, health and recreational benefits of allotments, there is a growing interest in the biodiversity value of these unique mosaics of intensively managed habitat (Gilbert, 1991). However, to date there has been little published research which concentrates on them.

Marshall (2009) used a questionnaire-based survey to assess garden and allotment biodiversity and attitudes to it. He found that, among other things, having direct contact with plants and wild animals in a garden or allotment helped foster a wider interest in nature. Thus, allotments, because they typically involve a cross-section of a community, can offer an ideal opportunity to engage people on an individual or community level and allow them to take a greater interest in their local wildlife.

The aims of our research were to test any variation in epigeal (ground-dwelling) invertebrate abundance and diversity along an urban-rural gradient, in relation to any effects of allotment plot management styles i.e. traditional or wildlife-friendly.

GENERAL APPROACH

A questionnaire-based survey was used to determine plot-holder attitudes to allotment management styles and the importance of wildlife on the sites. From these data, individual plots across allotment sites in east Yorkshire were identified to sample the epigeal invertebrates. In addition, plots were assigned as being either 'traditional' or 'wildlife-friendly' based on self-declaration. A range of environmental data were collected to determine the urban-rural gradient e.g. rural sites were likely to have a high percentage of surrounding farmland whilst urban sites were likely to have a high percentage of surrounding hard cover. These data were informed by the results of the Biodiversity in Urban Gardens in Sheffield (BUGS) project which examined, among other things, garden invertebrate biodiversity (Smith *et al.*, 2006 a,b). Three pitfall traps, pooled per plot, were used to sample invertebrate abundance and diversity in May and September 2006 on six plots from each of seven sampling sites chosen (N = 6 x 7 x 2 – 10 plots compromised/vandalized = 74) . These sites represented an urban-rural gradient and each site contained three 'traditionally' managed plots and three organic, wildlife-friendly plots, as identified from the questionnaires.

BIOLOGICAL DATA

Pitfall trapping resulted in the collection of 11,718 individual organisms; eight taxa were subject to further analysis. There was a significant difference in the mean number of individuals per allotment site (Fig 1). The rural Driffield allotment site contained significantly lower overall invertebrate abundance compared to the Newland site in Hull city centre, which had the highest abundance. Although none of the other sites were statistically different from each other, there was a trend towards an increase in mean abundance moving towards the city centre.

Beetles (Coleoptera) constituted 37.95%, woodlice (Isopoda) 24.03% and spiders (Araneae), 16.93% of the catch respectively. Urban sites tended to be dominated by woodlice whilst beetles tended to be more common on some suburban and rural sites. The results for spiders and the other five taxa, whose abundance ranged between 0.73% - 8.96% of the total catch, showed mixed abundance across the urban-rural gradient (Fig 2).

With regard to overall invertebrate abundance in relation to management styles, the urban wildlife-friendly managed plots contained significantly higher abundance compared to all other plots, except the urban traditional plots. The latter, whilst not statistically significant, did not contain such high abundance as the urban wildlife plots. This therefore highlighted a trend towards increased abundance along the rural, suburban, urban gradient, especially on those plots managed in a wildlife-friendly way.

The effects of management style on individual taxa gave mixed results; different taxa dominated over differing management styles. Beetles were significantly more abundant on traditionally managed plots. In contrast, the woodlice, slugs and snails (Mollusca) were significantly more abundant on wildlife-friendly managed plots. Spiders, opilione, millipedes and centipedes (Myriapoda) showed little difference in abundance in relation to management style. The most biologically diverse plots were managed in a wildlife-friendly way, with the highest diversity found on a rural site at Driffield. Interestingly, this site also contained the lowest diversity on the traditionally managed plots.

DISCUSSION

This study has shown that there is considerable interest from allotment plot-holders in projects that recognize the value of "their" allotments. Whilst older men still dominate, there are an increasing number of community groups, younger families and especially women, taking on allotments. The latter are also more likely to place a higher value on the wildlife on their plots and sites, as shown by their commitment to manage their plots in an organic, wildlife-friendly way.

The epigeal invertebrate taxa on the seven allotment sites studied showed a significant variation in both abundance and diversity along an urban-rural gradient. In contrast to what may have been expected, the urban sites contained the highest abundance whilst the rural sites contained the lowest. Whist urban sites are likely to be subject to a higher range of anthropogenic pressures, each allotment site may be a small-scale biodiversity oasis, due partly to the lack of other suitable surrounding habitat patches compared to rural areas.

The composition of the taxa found in the current study was similar to that of the BUGS studies mentioned above, but the actual proportions of some of the taxa were quite different. For example, Smith *et al.* (2006_b) found that the three most abundant taxa of the pitfall traps were woodlice (45%), beetles (25%) and slugs (19%) respectively, whilst in the current study they constituted 24%, 38% and 9% respectively. The most abundant taxa, the beetles, dominated the rural, and to lesser extent suburban, sites. The woodlice, however, dominated the urban sites, suggesting that they prefer synanthropic environments. In addition, spiders contributed 17% of the total catch, compared to less than 5% in the BUGS study.

The reasons for these differences are likely to be many and require further exploration. However, in the case of the slugs, it is likely that this group would be very actively discouraged from allotments, due to their primary *raison d'être* as a means of growing food crops. Slug pellets were the most common pesticide used, as evidenced in the questionnaires, supporting this conclusion.

Whilst management style suggests no *overall* difference in total invertebrate abundance, the differences at geographic scale do appear to show some effect. The higher abundance found on the wildlife-friendly allotment plots in the city centre may be due to a skewed effect of the high number of woodlice on these plots, as discussed above.

Overall, the diversity of the taxa found suggests that allotments are valuable habitats for epigeal invertebrates. The highest invertebrate diversity, found at the rural Driffield wildlife-friendly plots, corresponds with their low abundance and requires further study to try and explain the reasons. The environmental data gathered suggests that the high proportion of farmland surrounding the allotment site may account for some of the variation. Species are likely to be able to disperse readily into the surrounding habitat, unlike the more constrained urban habitat patches.

FUTURE WORK

Further work is ongoing to identify the three most abundant taxa to species level from a rural, suburban and urban allotment site respectively. Additional analysis of the questionnaire data, environmental and biological data will be published separately in due course. This work will therefore provide some much-needed empirical data on the epigeal invertebrate communities present on Yorkshire allotments. This baseline information could then be used to explore further issues such as biological control methods or effects of climate change on crop growing on allotments.

CONCLUSIONS

The increase in popularity of allotments offers a great opportunity to study the wildlife benefits of such sites, particularly in urban areas where greenspace is at a premium. In order to advance these studies, it is important to engage with individual plot-holders.

The epigeal invertebrate taxa found on these allotments are similar to those found in garden studies, but the proportions of dominating taxa vary across the urban-rural gradient and with management styles. Abundance was higher on urban plots, especially wildlife-friendly managed ones, compared to both traditionally and wildlife-friendly managed plots on rural or suburban sites. Invertebrate diversity was highest on some wildlife-friendly rural plots, which also had low abundance. Future work will help identify the specific species present and provide further clues to their ecological role on allotment sites.

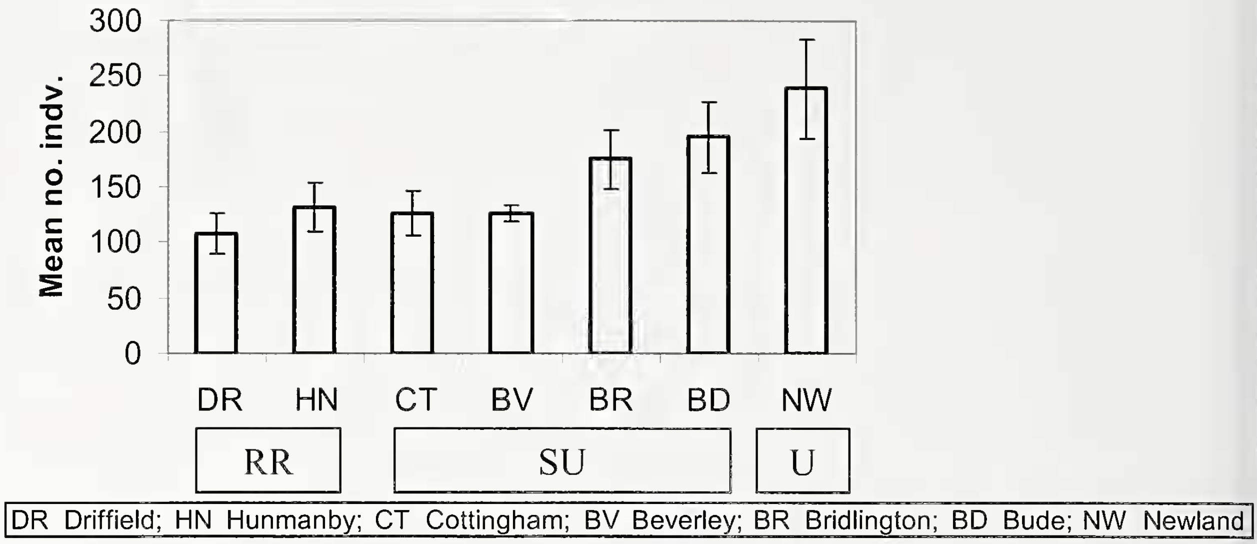

Fig. 1. Mean number of invertebrates per Yorkshire allotment site (± SE), based on individual plot totals (N=74), grouped per urban-rural gradient. (RR=rural; SU=suburban; UU=urban.)

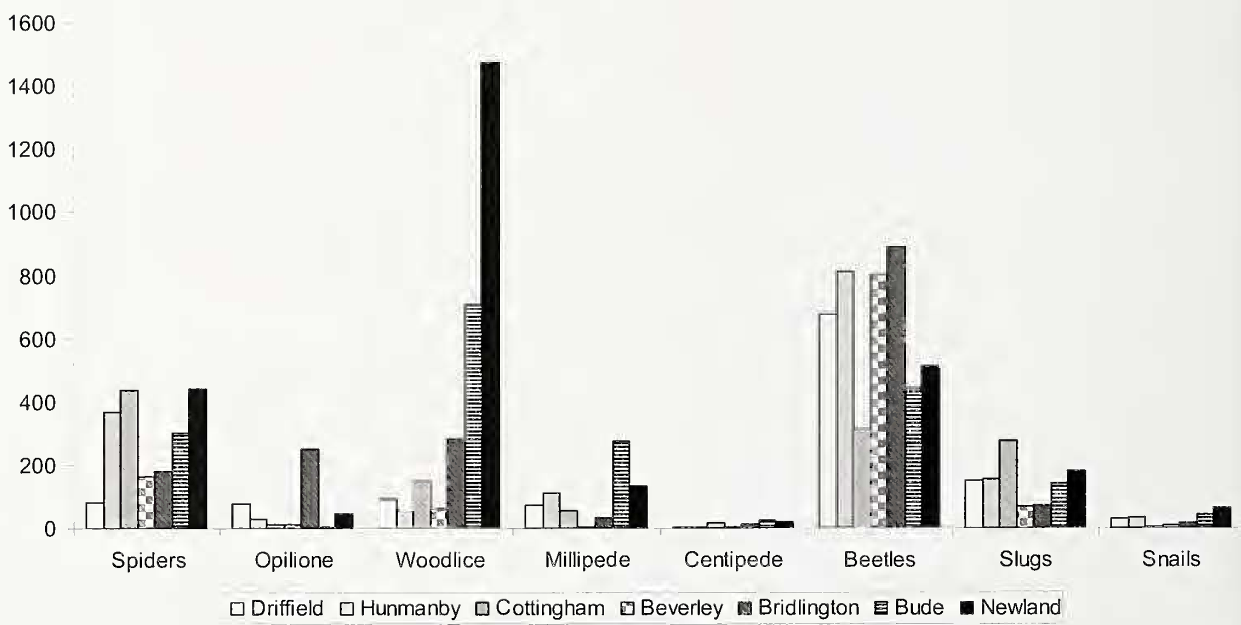

Fig. 2. Total number of each invertebrate taxon from pitfall-traps on seven Yorkshire allotment sites.

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Urban Biodiversity: Successes and Challanges: Brownfields: oases of urban biodiversity

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ABSTRACT
Despite their potential to support biodiversity, a strong negative public image has been attached to brownfield sites, with the conservation of these sites therefore lagging behind other habitats. The inclusion of 'Open Mosaic Habitats on Previously Developed Land (OMHPDL)' as a UK Biodiversity Action Plan (UKBAP) priority habitat has however resulted in a renewed focus on brownfields as important wildlife habitats. The experiences of Buglife – The Invertebrate Conservation Trust in both the Thames Gateway and central Scotland have shown that brownfield sites can support many rare, scarce and UKBAP priority species, some of which are becoming increasingly reliant on such sites as their natural habitats come under threat.

INTRODUCTION
The industrial revolution starting in the eighteenth century transformed the scenery of our towns and countryside. Central Scotland was at the heart of this revolution and many heavy engineering works and iron founders were based there. With the demise of these industries across the country, their former premises have been left derelict. Many of these ex-industrial sites have since been reclaimed by nature through natural succession.

This rich industrial heritage of Scotland has resulted in over 10,000 hectares of land being listed as vacant or derelict. These brownfield sites can be incredibly important for biodiversity, often supporting nationally important populations of rare and endangered invertebrates, alongside other wildlife such as birds, reptiles, plants and lichens. With the loss of natural habitats in the wider countryside through agricultural intensification and development, wild areas within the urban environment have become crucial to the survival of many increasingly threatened species in the UK. As a result Open Mosaic Habitat on Previously Developed Land (OMHPDL) was recently included as a UKBAP priority habitat.

Brownfields are any site that have been altered by human activity and are currently not fully in use (CABE, 2006). They tend to be concentrated in urban and former industrial landscapes but also include quarries, spoil heaps, old railway lines and disused airfields (Allan et al. 1997; Bodsworth et al. 2005; Whitehouse, 2008; Riding et al. 2010). Brownfield sites provide linkages or 'stepping stones' between more natural areas of habitat and facilitate the movement and mixing of individuals in a less favourable urban setting. Lack of management of brownfields often creates an open mosaic of habitats such as species rich grassland, bare ground and early successional habitats (Key, 2000; Bodsworth et al. 2005; Harvey et al. 2008). This, combined with a low nutrient content of the soil which prevents fast growing species becoming dominant, provides a continuity of resources for invertebrates throughout the season (Harvey et al. 2008). In addition, a mosaic of habitats provides a home for a wide range of species and allows many to complete their life cycles within the same site (Bodsworth et al. 2005).

It has long been recognised that brownfields may have as many associated Red Data Book (RDB) and Nationally Scarce invertebrate species as ancient woodlands (Jones, 2003). At least 194 invertebrate species of conservation importance, including 50 red data book and 131 nationally scarce species, have been recorded from brownfield sites in the UK. This includes 50% of rare solitary bees and wasps and 35% of rare ground beetles (Bodsworth et al. 2005). Brownfields also support a suite of UKBAP priority species. For example, the lack of management on brownfield sites often provides a secure area for breeding birds such as skylark (*Alauda arvensis*) and grey partridge (*Perdix perdix*), that are often absent from land under agricultural management. Many features identified at long abandoned industrial sites can no longer be found in the managed and over-farmed wider countryside or even in over-tidied parks (Bodsworth et al. 2005). Loss of natural habitat is causing many species, including bumblebees, beetles, butterflies and reptiles, to become increasingly reliant